PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-281190
(43)Date of publication of application : 15.10.1999

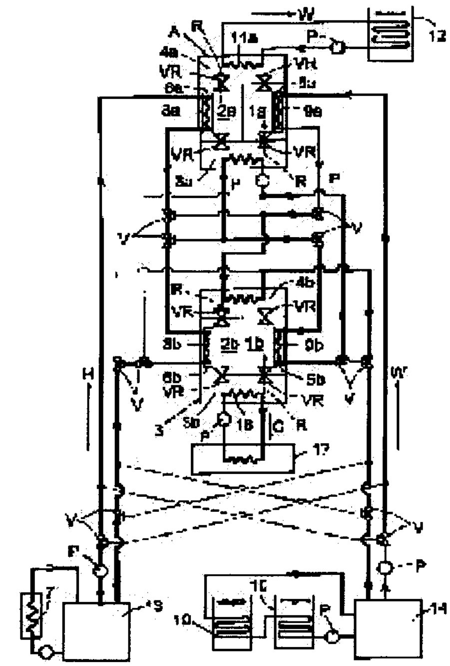
(51)Int.Cl. F25B 17/08

(21)Application number : 10-078991
(22)Date of filing : 26.03.1998

(71)Applicant : KUBOTA CORP
(72)Inventor : UCHIKAWA YASUO
KIMURA FUMIO

(54) DOUBLE ADSORPTION REFRIGERATING MACHINE

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance refrigeration output while reducing the size by supplying a second adsorption refrigerating machine with low temperature heat carrier cooled at the cold heat generating section of a first adsorption refrigerating machine.
SOLUTION: First and second adsorption refrigerating machines A, B comprise first and second adsorbent chambers 1a, 1b and 2a, 2b, evaporating chambers 3a, 3b and condensing chambers 4a, 4b, respectively. First and second adsorbing/desorbing operations are repeated at the first and second adsorption refrigerating machines A, B by switching valves VR and V. In the first adsorbing/desorbing operation, a process for evaporating refrigerant in the evaporating chambers 3a, 3b while adsorbing refrigerant vapor R to the adsorbents 5a, 5b in the first adsorbent chambers 1a, 1b under a state where the first adsorbent chambers 1a, 1b are communicating with the evaporating chambers 3a, 3b and the second adsorbent chambers 2a, 2b are communicating with the evaporating chambers 3a, 3b is executed in parallel with the process for desorbing adsorbed refrigerant R from the adsorbents 6a, 6b of the second adsorbent chambers 2a, 2b and desorbing the desorbed refrigerant vapor R through the condensers 4a, 4b.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The double adsorption refrigerator made the configuration which supplies the low-temperature heat carrier cooled in the cold energy generating section of the 1st adsorption refrigerator to the 2nd adsorption refrigerator as a heat carrier for adsorption material cooling in the adsorption process in the 2nd adsorption refrigerator.
[Claim 2] The double adsorption refrigerator according to claim 1 made the configuration which circulates said low-temperature heat carrier between the cold energy generating section of said 1st adsorption refrigerator, and the adsorption material cooling section of said 2nd adsorption refrigerator.
[Claim 3] The double adsorption refrigerator according to claim 1 or 2 made the configuration which supplies the elevated-temperature heat carrier for desorption from a common elevated-temperature heat source to said 1st adsorption refrigerator and said 2nd adsorption refrigerator.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an adsorption refrigerator.
[0002]
[Description of the Prior Art] Conventionally, in the adsorption refrigerator, generally, although adsorption material is cooled in an adsorption process, the feedwater from the cooling tower which cools circulating water by the heat dissipation to the open air is used.
[0003]
[Problem(s) to be Solved by the Invention] however, in adsorption material cooling by the feedwater from a cooling tower It is difficult for a limitation to be in low temperature-ization of whenever [in an adsorption process / adsorption material temperature], to make high phase counter pressure (= maximum vapor tension of the refrigerant of maximum vapor tension / whenever [adsorption material temperature / of the refrigerant in evaporation temperature (a desorption process condensation temperature)]) of an adsorption process for this reason, and to enlarge the equilibrium amount adsorbed of an adsorption process. Especially In the bottom of the condition to which the phase counter pressure of an adsorption process becomes lower than the phase counter pressure of a desorption process when the temperature of the elevated-temperature heat source for desorption is low It is only the temperature dependence (property that an equilibrium amount adsorbed decreases, so that whenever [adsorption material temperature] serves as an elevated temperature also under inphase counter pressure) of **** adsorption isotherm shown in drawing 3 (adsorption material is silica gel). The example which makes the equilibrium amount adsorbed of an adsorption process larger than the equilibrium amount adsorbed of a desorption process is also seen. There was also a problem to which a lot of adsorption material is taken to restrict a frozen output low in this point and the conventional adsorption refrigerator, and for there to be a problem that that improvement is difficult and it is difficult to make especially evaporation temperature low and to acquire low generating temperature, and to obtain a necessary frozen output from that, and equipment becomes large-sized.
[0004] The main technical problem of this invention is in the point which solves the problem like the above effectively by taking a rational equipment configuration to this actual condition.
[0005]
[Means for Solving the Problem] [1] In invention according to claim 1, the low-temperature heat carrier cooled in the cold energy generating section of the 1st adsorption refrigerator as a heat carrier for adsorption material cooling in the adsorption process in the 2nd adsorption refrigerator Since the 2nd adsorption refrigerator is supplied, in the 1st adsorption refrigerator as a heat carrier for adsorption material cooling in an adsorption process Though the thing of temperature comparable as the feedwater from a cooling tower or it is used, as usual in the 2nd adsorption refrigerator By effective adsorption material cooling by the above-mentioned low-temperature heat carrier obtained with the refrigerating effect of the 1st adsorption refrigerator, compared with the conventional machine, whenever [adsorption material temperature / of an adsorption process] can be reduced greatly, the phase counter pressure of an adsorption process can be raised sharply, and, thereby, the equilibrium amount adsorbed of an adsorption process can be increased greatly.
[0006] Moreover, there is no need of making it generating in the 1st adsorption refrigerator to the low generating temperature finally demanded as the whole equipment. the temperature which cooling of the adsorption material in the 2nd adsorption refrigerator takes is generated -- being sufficient -- since -- also about the 1st adsorption refrigerator, using the thing of temperature comparable as the feedwater from a cooling tower thru/or it for the heat carrier for adsorption material cooling Compared with the conventional machine, evaporation temperature can be made high, the phase counter pressure of an adsorption process can be raised, and, thereby, the equilibrium amount adsorbed of an adsorption process can be increased.
[0007] that is, from these things as a double adsorption refrigerator which combined the 1st adsorption refrigerator and the 2nd adsorption refrigerator Also in the bottom of the condition on which the temperature of the elevated-temperature heat source for desorption is low restrained though the thing of temperature comparable as the feedwater from a cooling tower or it is used for the heat carrier for adsorption material cooling supplied from outside the plane as usual It compares with the conventional adsorption refrigerator (so to speak adsorption refrigerator of a simplex) using the adsorption material of tales doses. A frozen higher output can be obtained from the cold energy generating section of the 2nd adsorption refrigerator, and since the phase counter pressure of an adsorption process is raised and a frozen output is raised especially, it becomes especially effective in making low evaporation temperature (evaporation temperature of the 2nd adsorption refrigerator), and acquiring low generating temperature. Moreover, by the ability of a frozen output to be improved in this way, although a necessary frozen output is obtained, the initial complement of adsorption material is lessened compared with the conventional machine, and equipment can be miniaturized effectively.
[0008] Although a frozen high output is obtained using an adsorption refrigerator and using for the heat carrier for adsorption material cooling in the adsorption process in an adsorption refrigerator the low-temperature heat carrier cooled as an exception method with refrigerators other than an adsorption refrigerator (for example, a steamy compression equation and an absorption type) is incidentally also considered By taking the configuration which combines adsorption refrigerators like the above compared with it In order not to use salts for the adsorption material

which does not use the chlorofluocarbon system refrigerant with a very small operation sound which the elevated-temperature heat source as a drive heat source can operate also at low temperature, there is an advantage which can maintain the merit of an adsorption refrigerator, like corrosion resistance and safety are high as it is.
[0009] In addition, it is not that by which the use number of an adsorption refrigerator is limited to two sets in operation of this invention. It may combine one by one in serial with the same combination gestalt as the combination gestalt of the 1st and 2nd adsorption refrigerator which described above three or more adsorption refrigerators, and three or more steps of double adsorption refrigerators may be constituted. Moreover, you may make it combine the two or more 2nd adsorption refrigerators in juxtaposition to the one 1st adsorption refrigerator.
[0010] [2] In invention according to claim 2, since said low-temperature heat carrier is circulated between the cold energy generating section of the 1st adsorption refrigerator, and the adsorption material cooling section of the 2nd adsorption refrigerator Namely, since a low-temperature heat carrier is circulated in a closed circuit, the temperature level of the circulatory system is effectively reduced by the generating cold energy of the 1st adsorption refrigerator. Low temperature-ization of whenever [in the adsorption process of the 2nd adsorption refrigerator / adsorption material temperature] can be promoted effectively. Moreover, the stripping loss to the exterior of the generating cold energy by the 1st adsorption refrigerator can also be inhibited, the generating cold energy of the 1st adsorption refrigerator can be made to contribute to adsorption material cooling with the 2nd adsorption refrigerator efficiently, and improvement in the frozen output which is the expected purpose can be realized much more effectively from these things.
[0011] Moreover, by circulating a low-temperature heat carrier in a closed circuit, a low-temperature heat carrier can be circulated under small pump power, and the rise of a running cost can also be inhibited.
[0012] [3] In invention according to claim 3, since the elevated-temperature heat carrier for desorption is supplied from a common elevated-temperature heat source to the 1st adsorption refrigerator and the 2nd adsorption refrigerator, what is necessary is just to prepare one elevated-temperature heat source like the conventional adsorption refrigerator (adsorption refrigerator of a simplex) as a double adsorption refrigerator which combined the 1st adsorption refrigerator and the 2nd adsorption refrigerator, and it becomes advantageous in respect of versatility or installation nature.
[0013]
[Embodiment of the Invention] In drawing 1 , A is the 1st adsorption refrigerator, B is the 2nd adsorption refrigerator, and each of these 1st and 2nd adsorption refrigerators A and B is equipped with the 1st adsorption material rooms 1a and 1b, 2nd adsorption material room 2a, 2b, evaporation chambers 3a and 3b, and the condensation rooms 4a and 4b.
[0014] Operation repeats the 1st adsorption-and-desorption operation and the 2nd adsorption-and-desorption operation alternately with predetermined time every in each of the 1st and 2nd adsorption refrigerators A and B by switch of Valves VR and V. In the 1st adsorption-and-desorption operation In the condition of having made the 1st adsorption material rooms 1a and 1b and evaporation chambers 3a and 3b opening for free passage, and having made 2nd adsorption material room 2a, 2b, and the condensation rooms 4a and 4b opening for free passage as shown in drawing 1 The adsorption process which evaporates Refrigerant R in evaporation chambers 3a and 3b while making the refrigerant steam R stick to the adsorption material 5a and 5b of the 1st adsorption material rooms 1a and 1b, Concurrency implementation of the desorption process which carries out desorption of the previous adsorption refrigerant R from 2nd adsorption material room 2a and the adsorption material 6a and 6b of 2b, and makes the desorption refrigerant steam R condense at the condensation rooms 4a and 4b is carried out.
[0015] By the 2nd adsorption-and-desorption operation, as shown in drawing 2 , in moreover, the condition of having made 2nd adsorption material room 2a, 2b, and evaporation chambers 3a and 3b opening for free passage, and having made the 1st adsorption material rooms 1a and 1b and the condensation rooms 4a and 4b opening for free passage The adsorption process which evaporates Refrigerant R in evaporation chambers 3a and 3b while making the refrigerant steam R stick to 2nd adsorption material room 2a and the adsorption material 6a and 6b of 2b, Concurrency implementation of the desorption process which carries out desorption of the previous adsorption refrigerant R from the adsorption material 5a and 5b of the 1st adsorption material rooms 1a and 1b, and makes the desorption refrigerant steam R condense at the condensation rooms 4a and 4b is carried out.
[0016] In addition, although illustration is omitted, the pour way which pours in into evaporation chambers 3a and 3b the refrigerant R made to condense at the condensation rooms 4a and 4b is established in each of the 1st and 2nd adsorption refrigerators A and B.
[0017] 7 is an elevated-temperature heat source. In the 1st adsorption-and-desorption operation (drawing 1) Circulation supply of the elevated-temperature heat carrier H for adsorption material heating (for desorption) is carried out from the elevated-temperature heat source H at the heat exchangers 8a and 8b (heat exchanger for adsorption material heating in this case) in 2nd adsorption material room 2a of the 1st and 2nd adsorption refrigerators A and B, and 2b. Desorption of the adsorption refrigerant R is carried out from these 2nd adsorption material room 2a and the adsorption material 6a and 6b of 2b. On the other hand, in the 2nd adsorption-and-desorption operation (drawing 2) Circulation supply of the elevated-temperature heat carrier H for adsorption material heating (for desorption) is carried out from the elevated-temperature heat source H at the heat exchangers 9a and 9b (heat exchanger for adsorption material heating in this case) in the 1st adsorption material rooms 1a and 1b of the 1st and 2nd adsorption refrigerators A and B. Desorption of the adsorption refrigerant R is carried out from the adsorption material 5a and 5b of these 1st adsorption material rooms 1a and 1b.
[0018] 10 is the 1st cooling tower of 2 ream disposition. In the 1st adsorption-and-desorption operation (drawing 1) Heat exchanger 9a in 1st adsorption material room 1a of the 1st adsorption refrigerator A (in this case) Circulation supply of the cooling water W is carried out from the 1st cooling tower 10 at the heat exchanger for adsorption material cooling, and heat exchanger 11b for condensation in condensation room 4b of the 2nd adsorption refrigerator B. By this While making the generating refrigerant steam R in evaporation-chamber 3a stick to adsorption material 5of 1st adsorption material room 1a a in the 1st adsorption refrigerator A, the desorption refrigerant steam R in 2nd adsorption material room 2b is made to condense in condensation room 4b of the 2nd adsorption refrigerator B.
[0019] Moreover, heat exchanger 8a [in / by the 2nd adsorption-and-desorption operation (drawing 2) / 2nd adsorption material room 2a of the 1st adsorption refrigerator A] (in this case) Circulation supply of the cooling water W is carried out from the 1st cooling tower 10 at the heat exchanger for adsorption material cooling, and heat exchanger 11b for condensation in condensation room 4b of the 2nd adsorption refrigerator B. By this While making the generating refrigerant steam R in evaporation-chamber 3a stick to adsorption material 6of 2nd adsorption material

room 2a a in the 1st adsorption refrigerator A, the desorption refrigerant steam R in 1st adsorption material room 1b is made to condense in condensation room 4b of the 2nd adsorption refrigerator B.
[0020] 12 is the 2nd cooling tower which carries out circulation supply of the cooling water W to heat exchanger 11a for condensation in condensation room 4a of the 1st adsorption refrigerator A. In the 1st adsorption-and-desorption operation (drawing 1) The desorption refrigerant steam R in 2nd adsorption material room 2a is made to condense in condensation room 4a of the 1st adsorption refrigerator A by cooling water supply from this 2nd cooling tower 12. In the 2nd adsorption-and-desorption operation (drawing 2) The desorption refrigerant steam R in 1st adsorption material room 1a is made to condense in condensation room 4a of the 1st adsorption refrigerator A by cooling water supply from this 2nd cooling tower 12.
[0021] The inside P of drawing is the change-over valve to which a pump and V switch the method valve of three, and VR switches the flow of the refrigerant steam R. Moreover, the buffer tank for elevated-temperature heat carriers in 13 and 14 are the buffer tanks for cooling water.
[0022] 15 is a heat exchanger for cooling to which heat exchange of Refrigerant R and the low-temperature heat carrier X for adsorption material cooling is carried out by evaporation-chamber 3a in the 1st adsorption refrigerator A, and cools the low-temperature refrigerant X in each of the 1st and 2nd adsorption-and-desorption operation by the heat-of-vaporization deprivation by the refrigerant evaporation by evaporation-chamber 3a.
[0023] In the 1st adsorption-and-desorption operation (drawing 1), the above-mentioned low-temperature refrigerant X is circulated between this heat exchanger 15 for cooling, and heat exchanger 9b (heat exchanger for adsorption material cooling in this case) in 1st adsorption material room 1b of the 2nd adsorption refrigerator B. And by this Adsorption material 5of 1st adsorption material room 1b in 2nd adsorption refrigerator B b is cooled by the generating cold energy of the 1st adsorption refrigerator A, and the generating refrigerant steam R in evaporation-chamber 3b is made to stick to adsorption material 5of the 1st adsorption material room 1b b.
[0024] In the 2nd adsorption-and-desorption operation (drawing 2), the above-mentioned low-temperature refrigerant X is circulated between this heat exchanger 15 for cooling, and heat exchanger 8b (heat exchanger for adsorption material cooling in this case) in 2nd adsorption material room 2b of the 2nd adsorption refrigerator B. Moreover, by this Adsorption material 6b of 2nd adsorption material room 2b in the 2nd adsorption refrigerator B is cooled by the generating cold energy of the 1st adsorption refrigerator A, and the generating refrigerant steam R in evaporation-chamber 3b is made to stick to adsorption material 6b of the 2nd adsorption material room 2b.
[0025] 16 is a heat exchanger for cooling as the output section to which heat exchange of the cold energy intermediation C which carries out circulation supply to Refrigerant R and load equipment 17 (for example, air-conditioning machine) by evaporation-chamber 3b in the 2nd adsorption refrigerator B is carried out, and cools the circulation cold energy intermediation C in each of the 1st and 2nd adsorption-and-desorption operation by the heat-of-vaporization deprivation by the refrigerant evaporation by evaporation-chamber 3b.
[0026] This equipment that is, the low-temperature heat carrier X cooled by the heat exchanger 15 for cooling as the cold energy generating section in the 1st adsorption refrigerator A the adsorption material cooling section (the 1st adsorption-and-desorption operation -- heat exchanger 9b --) in the heat exchanger 15 for cooling and 2nd adsorption refrigerator B In the 2nd adsorption-and-desorption operation, it is made to circulate between heat exchanger 8b, and has considered as the double adsorption refrigerator which uses the low-temperature heat carrier X for the heat carrier for adsorption material cooling in the adsorption process in the 2nd adsorption refrigerator B.
[0027] In addition, if silica gel, a zeolite, activated carbon, an activated alumina, etc. have adsorbent, they can use various things for the adsorption material 5a, 5b, 6a, and 6b.
[0028] Moreover, although the adsorption material 5a and 5b used with the 1st adsorption refrigerator A differs from the adsorption material 6a and 6b used with the 2nd adsorption refrigerator B in the same thing or each other, it may be any.
[0029] Although it is common to Refrigerant R to use water If adsorption and desorption are possible, the refrigerant R which can use various things and is used with the 1st adsorption refrigerator A, and the refrigerant R used with the 2nd adsorption refrigerator B The same thing, Or you may be any of a mutually different thing (for example, it uses for the 1st adsorption refrigerator A with alcohol at Refrigerant R, and water is used for Refrigerant R in the 2nd adsorption refrigerator B).

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to an adsorption refrigerator.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Conventionally, in the adsorption refrigerator, generally, although adsorption material is cooled in an adsorption process, the feedwater from the cooling tower which cools circulating water by the heat dissipation to the open air is used.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] however, in adsorption material cooling by the feedwater from a cooling tower It is difficult for a limitation to be in low temperature-ization of whenever [in an adsorption process / adsorption material temperature], to make high phase counter pressure (= maximum vapor tension of the refrigerant of maximum vapor tension / whenever [adsorption material temperature / of the refrigerant in evaporation temperature (a desorption process condensation temperature)]) of an adsorption process for this reason, and to enlarge the equilibrium amount adsorbed of an adsorption process. Especially In the bottom of the condition to which the phase counter pressure of an adsorption process becomes lower than the phase counter pressure of a desorption process when the temperature of the elevated-temperature heat source for desorption is low It is only the temperature dependence (property that an equilibrium amount adsorbed decreases, so that whenever [adsorption material temperature] serves as an elevated temperature also under inphase counter pressure) of **** adsorption isotherm shown in drawing 3 (adsorption material is silica gel). The example which makes the equilibrium amount adsorbed of an adsorption process larger than the equilibrium amount adsorbed of a desorption process is also seen. There was also a problem to which a lot of adsorption material is taken to restrict a frozen output low in this point and the conventional adsorption refrigerator, and for there to be a problem that that improvement is difficult and it is difficult to make especially evaporation temperature low and to acquire low generating temperature, and to obtain a necessary frozen output from that, and equipment becomes large-sized.
[0004] The main technical problem of this invention is in the point which solves the problem like the above effectively by taking a rational equipment configuration to this actual condition.

[Translation done.]

MEANS

[Means for Solving the Problem] [1] In invention according to claim 1, the low-temperature heat carrier cooled in the cold energy generating section of the 1st adsorption refrigerator as a heat carrier for adsorption material cooling in the adsorption process in the 2nd adsorption refrigerator Since the 2nd adsorption refrigerator is supplied, in the 1st adsorption refrigerator as a heat carrier for adsorption material cooling in an adsorption process Though the thing of temperature comparable as the feedwater from a cooling tower or it is used, as usual in the 2nd adsorption refrigerator By effective adsorption material cooling by the above-mentioned low-temperature heat carrier obtained with the refrigerating effect of the 1st adsorption refrigerator, compared with the conventional machine, whenever [adsorption material temperature / of an adsorption process] can be reduced greatly, the phase counter pressure of an adsorption process can be raised sharply, and, thereby, the equilibrium amount adsorbed of an adsorption process can be increased greatly.
[0006] Moreover, there is no need of making it generating in the 1st adsorption refrigerator to the low generating temperature finally demanded as the whole equipment. the temperature which cooling of the adsorption material in the 2nd adsorption refrigerator takes is generated -- being sufficient -- since -- also about the 1st adsorption refrigerator, using the thing of temperature comparable as the feedwater from a cooling tower thru/or it for the heat carrier for adsorption material cooling Compared with the conventional machine, evaporation temperature can be made high, the phase counter pressure of an adsorption process can be raised, and, thereby, the equilibrium amount adsorbed of an adsorption process can be increased.
[0007] that is, from these things as a double adsorption refrigerator which combined the 1st adsorption refrigerator and the 2nd adsorption refrigerator Also in the bottom of the condition on which the temperature of the elevated-temperature heat source for desorption is low restrained though the thing of temperature comparable as the feedwater from a cooling tower or it is used for the heat carrier for adsorption material cooling supplied from outside the plane as usual It compares with the conventional adsorption refrigerator (so to speak adsorption refrigerator of a simplex) using the adsorption material of tales doses. A frozen higher output can be obtained from the cold energy generating section of the 2nd adsorption refrigerator, and since the phase counter pressure of an adsorption process is raised and a frozen output is raised especially, it becomes especially effective in making low evaporation temperature (evaporation temperature of the 2nd adsorption refrigerator), and acquiring low generating temperature. Moreover, by the ability of a frozen output to be improved in this way, although a necessary frozen output is obtained, the initial complement of adsorption material is lessened compared with the conventional machine, and equipment can be miniaturized effectively.
[0008] Although a frozen high output is obtained using an adsorption refrigerator and using for the heat carrier for adsorption material cooling in the adsorption process in an adsorption refrigerator the low-temperature heat carrier cooled as an exception method with refrigerators other than an adsorption refrigerator (for example, a steamy compression equation and an absorption type) is incidentally also considered By taking the configuration which combines adsorption refrigerators like the above compared with it In order not to use salts for the adsorption material which does not use the chlorofluocarbon system refrigerant with a very small operation sound which the elevated-temperature heat source as a drive heat source can operate also at low temperature, there is an advantage which can maintain the merit of an adsorption refrigerator, like corrosion resistance and safety are high as it is.
[0009] In addition, it is not that by which the use number of an adsorption refrigerator is limited to two sets in operation of this invention. It may combine one by one in serial with the same combination gestalt as the combination gestalt of the 1st and 2nd adsorption refrigerator which described above three or more adsorption refrigerators, and three or more steps of double adsorption refrigerators may be constituted. Moreover, you may make it combine the two or more 2nd adsorption refrigerators in juxtaposition to the one 1st adsorption refrigerator.
[0010] [2] In invention according to claim 2, since said low-temperature heat carrier is circulated between the cold energy generating section of the 1st adsorption refrigerator, and the adsorption material cooling section of the 2nd adsorption refrigerator Namely, since a low-temperature heat carrier is circulated in a closed circuit, the temperature level of the circulatory system is effectively reduced by the generating cold energy of the 1st adsorption refrigerator. Low temperature-ization of whenever [in the adsorption process of the 2nd adsorption refrigerator / adsorption material temperature] can be promoted effectively. Moreover, the stripping loss to the exterior of the generating cold energy by the 1st adsorption refrigerator can also be inhibited, the generating cold energy of the 1st adsorption refrigerator can be made to contribute to adsorption material cooling with the 2nd adsorption refrigerator efficiently, and improvement in the frozen output which is the expected purpose can be realized much more effectively from these things.
[0011] Moreover, by circulating a low-temperature heat carrier in a closed circuit, a low-temperature heat carrier can be circulated under small pump power, and the rise of a running cost can also be inhibited.
[0012] [3] In invention according to claim 3, since the elevated-temperature heat carrier for desorption is supplied from a common elevated-temperature heat source to the 1st adsorption refrigerator and the 2nd adsorption refrigerator, what is necessary is just to prepare one elevated-temperature heat source like the conventional adsorption refrigerator (adsorption refrigerator of a simplex) as a double adsorption refrigerator which combined the 1st adsorption refrigerator and the 2nd adsorption refrigerator, and it becomes advantageous in respect of versatility or installation nature.
[0013]

[Embodiment of the Invention] In drawing 1 , A is the 1st adsorption refrigerator, B is the 2nd adsorption refrigerator, and each of these 1st and 2nd adsorption refrigerators A and B is equipped with the 1st adsorption material rooms 1a and 1b, 2nd adsorption material room 2a, 2b, evaporation chambers 3a and 3b, and the condensation rooms 4a and 4b.
[0014] Operation repeats the 1st adsorption-and-desorption operation and the 2nd adsorption-and-desorption operation alternately with predetermined time every in each of the 1st and 2nd adsorption refrigerators A and B by switch of Valves VR and V. In the 1st adsorption-and-desorption operation In the condition of having made the 1st adsorption material rooms 1a and 1b and evaporation chambers 3a and 3b opening for free passage, and having made 2nd adsorption material room 2a, 2b, and the condensation rooms 4a and 4b opening for free passage as shown in drawing 1 The adsorption process which evaporates Refrigerant R in evaporation chambers 3a and 3b while making the refrigerant steam R stick to the adsorption material 5a and 5b of the 1st adsorption material rooms 1a and 1b, Concurrency implementation of the desorption process which carries out desorption of the previous adsorption refrigerant R from 2nd adsorption material room 2a and the adsorption material 6a and 6b of 2b, and makes the desorption refrigerant steam R condense at the condensation rooms 4a and 4b is carried out.
[0015] By the 2nd adsorption-and-desorption operation, as shown in drawing 2 , in moreover, the condition of having made 2nd adsorption material room 2a, 2b, and evaporation chambers 3a and 3b opening for free passage, and having made the 1st adsorption material rooms 1a and 1b and the condensation rooms 4a and 4b opening for free passage The adsorption process which evaporates Refrigerant R in evaporation chambers 3a and 3b while making the refrigerant steam R stick to 2nd adsorption material room 2a and the adsorption material 6a and 6b of 2b, Concurrency implementation of the desorption process which carries out desorption of the previous adsorption refrigerant R from the adsorption material 5a and 5b of the 1st adsorption material rooms 1a and 1b, and makes the desorption refrigerant steam R condense at the condensation rooms 4a and 4b is carried out.
[0016] In addition, although illustration is omitted, the pour way which pours in into evaporation chambers 3a and 3b the refrigerant R made to condense at the condensation rooms 4a and 4b is established in each of the 1st and 2nd adsorption refrigerators A and B.
[0017] 7 is an elevated-temperature heat source. In the 1st adsorption-and-desorption operation (drawing 1) Circulation supply of the elevated-temperature heat carrier H for adsorption material heating (for desorption) is carried out from the elevated-temperature heat source H at the heat exchangers 8a and 8b (heat exchanger for adsorption material heating in this case) in 2nd adsorption material room 2a of the 1st and 2nd adsorption refrigerators A and B, and 2b. Desorption of the adsorption refrigerant R is carried out from these 2nd adsorption material room 2a and the adsorption material 6a and 6b of 2b. On the other hand, in the 2nd adsorption-and-desorption operation (drawing 2) Circulation supply of the elevated-temperature heat carrier H for adsorption material heating (for desorption) is carried out from the elevated-temperature heat source H at the heat exchangers 9a and 9b (heat exchanger for adsorption material heating in this case) in the 1st adsorption material rooms 1a and 1b of the 1st and 2nd adsorption refrigerators A and B. Desorption of the adsorption refrigerant R is carried out from the adsorption material 5a and 5b of these 1st adsorption material rooms 1a and 1b.
[0018] 10 is the 1st cooling tower of 2 ream disposition. In the 1st adsorption-and-desorption operation (drawing 1) Heat exchanger 9a in 1st adsorption material room 1a of the 1st adsorption refrigerator A (in this case) Circulation supply of the cooling water W is carried out from the 1st cooling tower 10 at the heat exchanger for adsorption material cooling, and heat exchanger 11b for condensation in condensation room 4b of the 2nd adsorption refrigerator B. By this While making the generating refrigerant steam R in evaporation-chamber 3a stick to adsorption material 5of 1st adsorption material room 1a a in the 1st adsorption refrigerator A, the desorption refrigerant steam R in 2nd adsorption material room 2b is made to condense in condensation room 4b of the 2nd adsorption refrigerator B.
[0019] Moreover, heat exchanger 8a [in / by the 2nd adsorption-and-desorption operation (drawing 2) / 2nd adsorption material room 2a of the 1st adsorption refrigerator A] (in this case) Circulation supply of the cooling water W is carried out from the 1st cooling tower 10 at the heat exchanger for adsorption material cooling, and heat exchanger 11b for condensation in condensation room 4b of the 2nd adsorption refrigerator B. By this While making the generating refrigerant steam R in evaporation-chamber 3a stick to adsorption material 6of 2nd adsorption material room 2a a in the 1st adsorption refrigerator A, the desorption refrigerant steam R in 1st adsorption material room 1b is made to condense in condensation room 4b of the 2nd adsorption refrigerator B.
[0020] 12 is the 2nd cooling tower which carries out circulation supply of the cooling water W to heat exchanger 11a for condensation in condensation room 4a of the 1st adsorption refrigerator A. In the 1st adsorption-and-desorption operation (drawing 1) The desorption refrigerant steam R in 2nd adsorption material room 2a is made to condense in condensation room 4a of the 1st adsorption refrigerator A by cooling water supply from this 2nd cooling tower 12. In the 2nd adsorption-and-desorption operation (drawing 2) The desorption refrigerant steam R in 1st adsorption material room 1a is made to condense in condensation room 4a of the 1st adsorption refrigerator A by cooling water supply from this 2nd cooling tower 12.
[0021] The inside P of drawing is the change-over valve to which a pump and V switch the method valve of three, and VR switches the flow of the refrigerant steam R. Moreover, the buffer tank for elevated-temperature heat carriers in 13 and 14 are the buffer tanks for cooling water.
[0022] 15 is a heat exchanger for cooling to which heat exchange of Refrigerant R and the low-temperature heat carrier X for adsorption material cooling is carried out by evaporation-chamber 3a in the 1st adsorption refrigerator A, and cools the low-temperature refrigerant X in each of the 1st and 2nd adsorption-and-desorption operation by the heat-of-vaporization deprivation by the refrigerant evaporation by evaporation-chamber 3a.
[0023] In the 1st adsorption-and-desorption operation (drawing 1), the above-mentioned low-temperature refrigerant X is circulated between this heat exchanger 15 for cooling, and heat exchanger 9b (heat exchanger for adsorption material cooling in this case) in 1st adsorption material room 1b of the 2nd adsorption refrigerator B. And by this Adsorption material 5of 1st adsorption material room 1b in 2nd adsorption refrigerator B b is cooled by the generating cold energy of the 1st adsorption refrigerator A, and the generating refrigerant steam R in evaporation-chamber 3b is made to stick to adsorption material 5of the 1st adsorption material room 1b b.
[0024] In the 2nd adsorption-and-desorption operation (drawing 2), the above-mentioned low-temperature refrigerant X is circulated between this heat exchanger 15 for cooling, and heat exchanger 8b (heat exchanger for adsorption material cooling in this case) in 2nd adsorption material room 2b of the 2nd adsorption refrigerator B. Moreover, by this Adsorption material 6b of 2nd adsorption material room 2b in the 2nd adsorption refrigerator B is cooled by the generating cold energy of the 1st adsorption refrigerator A, and the generating refrigerant steam R in

evaporation-chamber 3b is made to stick to adsorption material 6b of the 2nd adsorption material room 2b.
[0025] 16 is a heat exchanger for cooling as the output section to which heat exchange of the cold energy intermediation C which carries out circulation supply to Refrigerant R and load equipment 17 (for example, air-conditioning machine) by evaporation-chamber 3b in the 2nd adsorption refrigerator B is carried out, and cools the circulation cold energy intermediation C in each of the 1st and 2nd adsorption-and-desorption operation by the heat-of-vaporization deprivation by the refrigerant evaporation by evaporation-chamber 3b.
[0026] This equipment that is, the low-temperature heat carrier X cooled by the heat exchanger 15 for cooling as the cold energy generating section in the 1st adsorption refrigerator A the adsorption material cooling section (the 1st adsorption-and-desorption operation -- heat exchanger 9b --) in the heat exchanger 15 for cooling and 2nd adsorption refrigerator B In the 2nd adsorption-and-desorption operation, it is made to circulate between heat exchanger 8b, and has considered as the double adsorption refrigerator which uses the low-temperature heat carrier X for the heat carrier for adsorption material cooling in the adsorption process in the 2nd adsorption refrigerator B.
[0027] In addition, if silica gel, a zeolite, activated carbon, an activated alumina, etc. have adsorbent, they can use various things for the adsorption material 5a, 5b, 6a, and 6b.
[0028] Moreover, although the adsorption material 5a and 5b used with the 1st adsorption refrigerator A differs from the adsorption material 6a and 6b used with the 2nd adsorption refrigerator B in the same thing or each other, it may be any.
[0029] Although it is common to Refrigerant R to use water If adsorption and desorption are possible, the refrigerant R which can use various things and is used with the 1st adsorption refrigerator A, and the refrigerant R used with the 2nd adsorption refrigerator B The same thing, Or you may be any of a mutually different thing (for example, it uses for the 1st adsorption refrigerator A with alcohol at Refrigerant R, and water is used for Refrigerant R in the 2nd adsorption refrigerator B).

[Translation done.]

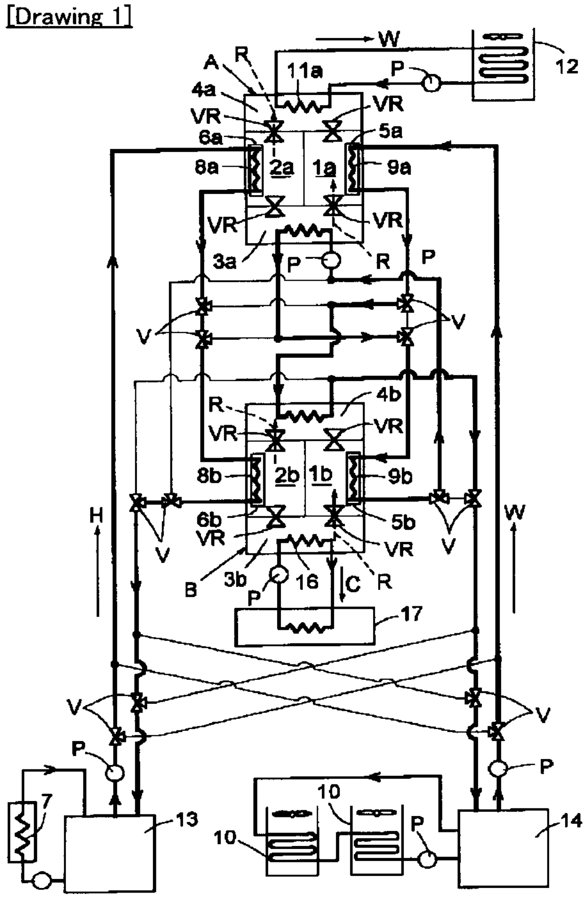
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing an equipment configuration and the operation gestalt of the 1st adsorption-and-desorption operation
[Drawing 2] Drawing showing the operation gestalt of the 2nd adsorption-and-desorption operation
[Drawing 3] The graph which shows the relation between phase counter pressure and an equilibrium amount adsorbed.
[Description of Notations]
A The 1st adsorption refrigerator
B The 2nd adsorption refrigerator
15 Cold Energy Generating Section of 1st Adsorption Refrigerator
8b, 9b The adsorption material cooling section of the 2nd adsorption refrigerator
7 Common Elevated-Temperature Heat Source
X Low-temperature heat carrier
H The elevated-temperature heat carrier for desorption

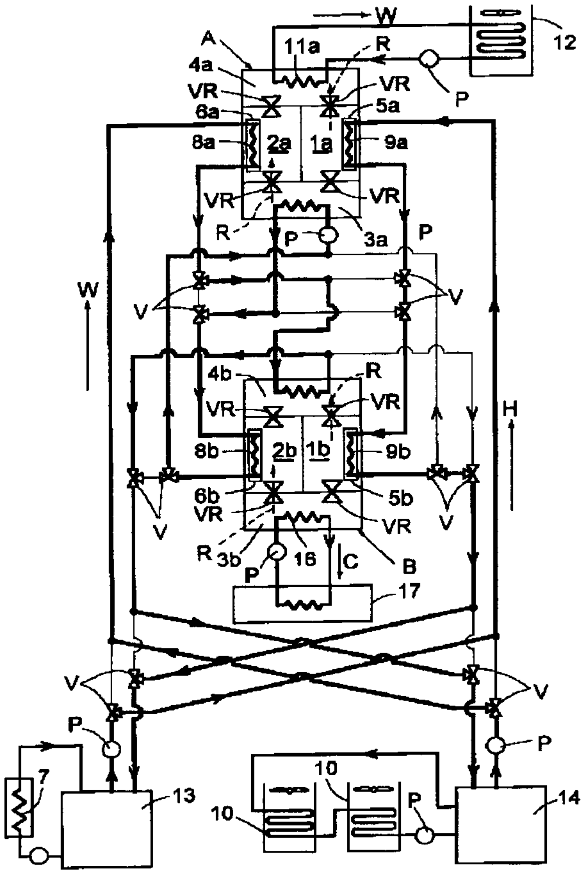
[Translation done.]

DRAWINGS

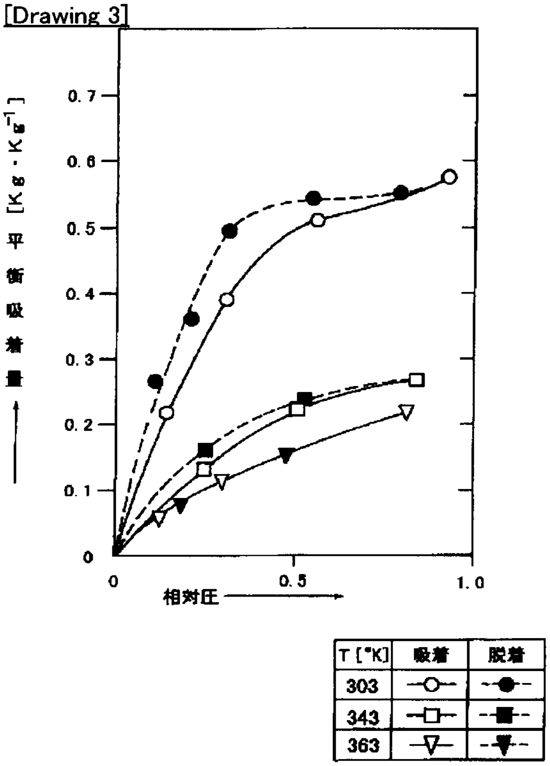
[Drawing 1]



[Drawing 2]


W
A
11a
R
12
4a
VR
5a
6a
8a
2a
1a
9a
P
3a
V
W
H
4b
8b
2b
1b
9b
6b
5b
3b
16
C
B
17
7
13
10
14

[Drawing 3]


0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1.0
平衡吸着量 [Kg・Kg⁻¹]
相対圧
T [°K]
吸着
脱着
303
343
363

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平11－281190

(43)公開日　平成11年(1999)10月15日

(51)Int.Cl.⁶　識別記号　ＦＩ
Ｆ２５Ｂ　17/08　Ｆ２５Ｂ　17/08　Ｅ

審査請求　未請求　請求項の数３　ＯＬ　（全 6 頁）

(21)出願番号　特願平10－78991

(22)出願日　平成10年(1998) ３月26日

(71)出願人　000001052
株式会社クボタ
大阪府大阪市浪速区敷津東一丁目２番47号

(72)発明者　内川　靖夫
兵庫県尼崎市浜１丁目１番１号　株式会社クボタ技術開発研究所内

(72)発明者　木村　二三夫
兵庫県尼崎市浜１丁目１番１号　株式会社クボタ技術開発研究所内

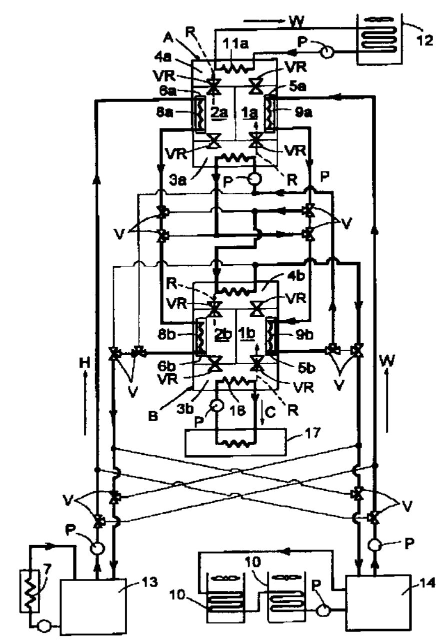
(74)代理人　弁理士　北村　修一郎

(54)【発明の名称】　複式吸着冷凍機

(57)【要約】

【課題】　吸着冷凍機の冷凍出力を効果的に向上させる。

【解決手段】　第１吸着冷凍機Ａの冷熱発生部１５で冷却した低温熱媒Ｘを、第２吸着冷凍機Ｂにおける吸着工程での吸着材冷却用熱媒として、その第２吸着冷凍機Ｂに供給する構成にする。また、その低温熱媒Ｘを、第１吸着冷凍機Ａの冷熱発生部１５と第２吸着冷凍機Ｂの吸着材冷却部９ｂ（ないし８ｂ）との間で循環させる構成にする。



【特許請求の範囲】

【請求項１】　第１吸着冷凍機の冷熱発生部で冷却した低温熱媒を、第２吸着冷凍機における吸着工程での吸着材冷却用熱媒として、その第２吸着冷凍機に供給する構成にしてある複式吸着冷凍機。

【請求項２】　前記低温熱媒を、前記第１吸着冷凍機の冷熱発生部と前記第２吸着冷凍機の吸着材冷却部との間で循環させる構成にしてある請求項１記載の複式吸着冷凍機。

【請求項３】　前記第１吸着冷凍機と前記第２吸着冷凍機とに対し共通の高温熱源から脱着用の高温熱媒を供給する構成にしてある請求項１又は２記載の複式吸着冷凍機。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は吸着冷凍機に関する。

【０００２】

【従来の技術】従来、吸着冷凍機では一般に、吸着工程において吸着材を冷却するのに、外気への放熱で循環水を冷却する冷却塔からの供給水を用いている。

【０００３】

【発明が解決しようとする課題】しかし、冷却塔からの供給水による吸着材冷却では、吸着工程における吸着材温度の低温化に限界があり、この為、吸着工程の相対圧（＝蒸発温度（脱着工程では凝縮温度）での冷媒の飽和蒸気圧／吸着材温度での冷媒の飽和蒸気圧）を高くして吸着工程の平衡吸着量を大きくすることが難しく、殊に、脱着用高温熱源の温度が低い場合には、吸着工程の相対圧が脱着工程の相対圧よりも低くなる条件下において、図３（吸着材はシリカゲル）に示す如き吸着等温線の温度依存性（同相対圧の下でも吸着材温度が高温となる程、平衡吸着量が減少する特性）だけで、吸着工程の平衡吸着量を脱着工程の平衡吸着量よりも大きくしている例も見られ、この点、従来の吸着冷凍機では冷凍出力が低く制限されて、その向上が難しく、特に蒸発温度を低くして低い発生温度を得ることが難しい問題があり、また、そのことから所要の冷凍出力を得るのに大量の吸着材を要して装置が大型になる問題もあった。

【０００４】この実情に対し、本発明の主たる課題は、合理的な装置構成を採ることにより上記の如き問題を効果的に解消する点にある。

【０００５】

【課題を解決するための手段】〔１〕請求項１記載の発明では、第１吸着冷凍機の冷熱発生部で冷却した低温熱媒を、第２吸着冷凍機における吸着工程での吸着材冷却用熱媒として、その第２吸着冷凍機に供給するから、第１吸着冷凍機では吸着工程での吸着材冷却用熱媒として、従来と同様、冷却塔からの供給水ないしはそれと同程度の温度のものを用いながらも、第２吸着冷凍機では、第１吸着冷凍機の冷凍効果をもって得た上記低温熱媒による効果的な吸着材冷却により、従来機に比べ、吸着工程の吸着材温度を大きく低下させて吸着工程の相対圧を大巾に高め、これにより、吸着工程の平衡吸着量を大きく増大させることができる。

【０００６】また、第１吸着冷凍機では、装置全体として最終的に要求される低い発生温度まで発生させる必要は無く、第２吸着冷凍機での吸着材の冷却に要する温度を発生させるだけでよいから、吸着材冷却用熱媒に冷却塔からの供給水ないしそれと同程度の温度のものを用いながら、その第１吸着冷凍機についても、従来機に比べ、蒸発温度を高くして吸着工程の相対圧を高め、これにより、吸着工程の平衡吸着量を増大させることができる。

【０００７】つまり、これらのことから、第１吸着冷凍機と第２吸着冷凍機とを組み合わせた複式の吸着冷凍機として、機外から供給する吸着材冷却用熱媒には従来と同様、冷却塔からの供給水ないしはそれと同程度の温度のものを用いながらも、また、脱着用高温熱源の温度が低く制約される条件下においても、同量の吸着材を用いる従来の吸着冷凍機（言わば単式の吸着冷凍機）に比べ、より高い冷凍出力を第２吸着冷凍機の冷熱発生部から得ることができ、殊に、吸着工程の相対圧を高めて冷凍出力を向上させることから、蒸発温度（第２吸着冷凍機の蒸発温度）を低くして低い発生温度を得るのに特に有効となる。また、このように冷凍出力を向上できることで、所要の冷凍出力を得るのに、従来機に比べ吸着材の必要量を少なくして装置を効果的に小型化できる。

【０００８】ちなみに、吸着冷凍機を用いて高い冷凍出力を得るのに、別法として、吸着冷凍機以外の冷凍機（例えば蒸気圧縮式や吸収式）で冷却した低温熱媒を吸着冷凍機における吸着工程での吸着材冷却用熱媒に用いることも考えられるが、それに比べ、上記の如く吸着冷凍機どうしを組み合わせる構成を採ることにより、駆動熱源としての高温熱源が低温でも運転できる、運転音が極めて小さい、フロン系冷媒を使用しない、吸着材に塩類を用いないため耐食性・安全性が高いなどの吸着冷凍機のメリットをそのまま維持できる利点がある。

【０００９】なお、本発明の実施にあたり、吸着冷凍機の使用台数は２台に限定されるものではなく、３台以上の吸着冷凍機を上記した第１及び第２吸着冷凍機の組み合わせ形態と同じ組み合わせ形態で直列的に順次組み合わせて３段以上の複式吸着冷凍機を構成してもよく、また、１台の第１吸着冷凍機に対し２台以上の第２吸着冷凍機を並列的に組み合わせるようにしてもよい。

【００１０】〔２〕請求項２記載の発明では、前記低温熱媒を第１吸着冷凍機の冷熱発生部と第２吸着冷凍機の吸着材冷却部との間で循環させるから、すなわち、低温熱媒を閉回路で循環させるから、その循環系の温度レベルを第１吸着冷凍機の発生冷熱により効果的に低下させ

て、第２吸着冷凍機の吸着工程における吸着材温度の低温化を効果的に促進でき、また、第１吸着冷凍機による発生冷熱の外部への放散ロスも抑止して第１吸着冷凍機の発生冷熱を第２吸着冷凍機での吸着材冷却に効率的に寄与させることができ、これらのことから、所期目的である冷凍出力の向上を一層効果的に実現できる。

【００１１】また、低温熱媒を閉回路で循環させることにより、小さいポンプ動力で低温熱媒を循環させることができて、ランニングコストの上昇も抑止できる。

【００１２】〔３〕請求項３記載の発明では、第１吸着冷凍機と第２吸着冷凍機とに対し共通の高温熱源から脱着用の高温熱媒を供給するから、第１吸着冷凍機と第２吸着冷凍機を組み合わせた複式吸着冷凍機として、従来の吸着冷凍機（単式の吸着冷凍機）と同様に１つの高温熱源を準備するだけですみ、汎用性や設置性の面で有利になる。

【００１３】

【発明の実施の形態】図１において、Ａは第１吸着冷凍機、Ｂは第２吸着冷凍機であり、これら第１及び第２吸着冷凍機Ａ，Ｂの夫々は、第１吸着材室１ａ，１ｂ、第２吸着材室２ａ，２ｂ、蒸発室３ａ，３ｂ、凝縮室４ａ，４ｂを備えている。

【００１４】運転は、弁ＶＲ，Ｖの切り換えにより第１及び第２吸着冷凍機Ａ，Ｂの夫々において第１吸脱着運転と第２吸脱着運転とを所定時間ずつ交互に繰り返し、第１吸脱着運転では、図１に示す如く、第１吸着材室１ａ，１ｂと蒸発室３ａ，３ｂとを連通させ、かつ、第２吸着材室２ａ，２ｂと凝縮室４ａ，４ｂとを連通させた状態で、第１吸着材室１ａ，１ｂの吸着材５ａ，５ｂに冷媒蒸気Ｒを吸着させながら蒸発室３ａ，３ｂで冷媒Ｒを蒸発させる吸着工程と、第２吸着材室２ａ，２ｂの吸着材６ａ，６ｂから先の吸着冷媒Ｒを脱着させてその脱着冷媒蒸気Ｒを凝縮室４ａ，４ｂで凝縮させる脱着工程とを並行実施する。

【００１５】また、第２吸脱着運転では、図２に示す如く、第２吸着材室２ａ，２ｂと蒸発室３ａ，３ｂとを連通させ、かつ、第１吸着材室１ａ，１ｂと凝縮室４ａ，４ｂとを連通させた状態で、第２吸着材室２ａ，２ｂの吸着材６ａ，６ｂに冷媒蒸気Ｒを吸着させながら蒸発室３ａ，３ｂで冷媒Ｒを蒸発させる吸着工程と、第１吸着材室１ａ，１ｂの吸着材５ａ，５ｂから先の吸着冷媒Ｒを脱着させてその脱着冷媒蒸気Ｒを凝縮室４ａ，４ｂで凝縮させる脱着工程とを並行実施する。

【００１６】なお、図示は省略してあるが、第１及び第２吸着冷凍機Ａ，Ｂの夫々には、凝縮室４ａ，４ｂで凝縮させた冷媒Ｒを蒸発室３ａ，３ｂへ還送する還送路を設けてある。

【００１７】７は高温熱源であり、第１吸脱着運転（図１）では、第１及び第２吸着冷凍機Ａ，Ｂの第２吸着材室２ａ，２ｂにおける熱交換器８ａ，８ｂ（この場合、吸着材加熱用の熱交換器）に高温熱源Ｈから吸着材加熱用（脱着用）の高温熱媒Ｈを循環供給して、これら第２吸着材室２ａ，２ｂの吸着材６ａ，６ｂから吸着冷媒Ｒを脱着させ、一方、第２吸脱着運転（図２）では、第１及び第２吸着冷凍機Ａ，Ｂの第１吸着材室１ａ，１ｂにおける熱交換器９ａ，９ｂ（この場合、吸着材加熱用の熱交換器）に高温熱源Ｈから吸着材加熱用（脱着用）の高温熱媒Ｈを循環供給して、これら第１吸着材室１ａ，１ｂの吸着材５ａ，５ｂから吸着冷媒Ｒを脱着させる。

【００１８】１０は２連配備の第１冷却塔であり、第１吸脱着運転（図１）では、第１吸着冷凍機Ａの第１吸着材室１ａにおける熱交換器９ａ（この場合、吸着材冷却用の熱交換器）と第２吸着冷凍機Ｂの凝縮室４ｂにおける凝縮用熱交換器１１ｂとに第１冷却塔１０から冷却水Ｗを循環供給し、これにより、第１吸着冷凍機Ａにおいて第１吸着材室１ａの吸着材５ａに蒸発室３ａでの発生冷媒蒸気Ｒを吸着させるとともに、第２吸着冷凍機Ｂの凝縮室４ｂにおいて第２吸着材室２ｂでの脱着冷媒蒸気Ｒを凝縮させる。

【００１９】また、第２吸脱着運転（図２）では、第１吸着冷凍機Ａの第２吸着材室２ａにおける熱交換器８ａ（この場合、吸着材冷却用の熱交換器）と第２吸着冷凍機Ｂの凝縮室４ｂにおける凝縮用熱交換器１１ｂとに第１冷却塔１０から冷却水Ｗを循環供給し、これにより、第１吸着冷凍機Ａにおいて第２吸着材室２ａの吸着材６ａに蒸発室３ａでの発生冷媒蒸気Ｒを吸着させるとともに、第２吸着冷凍機Ｂの凝縮室４ｂにおいて第１吸着材室１ｂでの脱着冷媒蒸気Ｒを凝縮させる。

【００２０】１２は第１吸着冷凍機Ａの凝縮室４ａにおける凝縮用熱交換器１１ａへ冷却水Ｗを循環供給する第２冷却塔であり、第１吸脱着運転（図１）では、この第２冷却塔１２からの冷却水供給により第１吸着冷凍機Ａの凝縮室４ａにおいて第２吸着材室２ａでの脱着冷媒蒸気Ｒを凝縮させ、第２吸脱着運転（図２）では、この第２冷却塔１２からの冷却水供給により第１吸着冷凍機Ａの凝縮室４ａにおいて第１吸着材室１ａでの脱着冷媒蒸気Ｒを凝縮させる。

【００２１】図中Ｐはポンプ、Ｖは３方弁、ＶＲは冷媒蒸気Ｒの流れを切り換える切換弁である。また、１３は高温熱媒用のバッファタンク、１４は冷却水用のバッファタンクである。

【００２２】１５は第１吸着冷凍機Ａにおける蒸発室３ａで冷媒Ｒと吸着材冷却用の低温熱媒Ｘとを熱交換させる冷却用熱交換器であり、第１及び第２吸脱着運転の夫々において蒸発室３ａでの冷媒蒸発による気化熱奪取で低温冷媒Ｘを冷却する。

【００２３】そして、第１吸脱着運転（図１）では、この冷却用熱交換器１５と第２吸着冷凍機Ｂの第１吸着材室１ｂにおける熱交換器９ｂ（この場合、吸着材冷却用の熱交換器）との間で上記の低温冷媒Ｘを循環させ、こ

れにより、第２吸着冷凍機Ｂにおける第１吸着材室１ｂの吸着材５ｂを第１吸着冷凍機Ａの発生冷熱により冷却して、その第１吸着材室１ｂの吸着材５ｂに蒸発室３ｂでの発生冷媒蒸気Ｒを吸着させる。

【００２４】また、第２吸脱着運転（図２）では、この冷却用熱交換器１５と第２吸着冷凍機Ｂの第２吸着材室２ｂにおける熱交換器８ｂ（この場合、吸着材冷却用の熱交換器）との間で上記の低温冷媒Ｘを循環させ、これにより、第２吸着冷凍機Ｂにおける第２吸着材室２ｂの吸着材６ｂを第１吸着冷凍機Ａの発生冷熱により冷却して、その第２吸着材室２ｂの吸着材６ｂに蒸発室３ｂでの発生冷媒蒸気Ｒを吸着させる。

【００２５】１６は第２吸着冷凍機Ｂにおける蒸発室３ｂで冷媒Ｒと負荷装置１７（例えば空調機）に対し循環供給する冷熱媒Ｃとを熱交換させる出力部としての冷却用熱交換器であり、第１及び第２吸脱着運転の夫々において蒸発室３ｂでの冷媒蒸発による気化熱奪取で循環冷熱媒Ｃを冷却する。

【００２６】つまり、この装置は、第１吸着冷凍機Ａにおける冷熱発生部としての冷却用熱交換器１５で冷却した低温熱媒Ｘを、その冷却用熱交換器１５と第２吸着冷凍機Ｂにおける吸着材冷却部（第１吸脱着運転では熱交換器９ｂ、第２吸脱着運転では熱交換器８ｂ）との間で循環させて、その低温熱媒Ｘを第２吸着冷凍機Ｂにおける吸着工程での吸着材冷却用熱媒に用いる複式吸着冷凍機としてある。

【００２７】なお、吸着材５ａ，５ｂ，６ａ，６ｂには、シリカゲル、ゼオライト、活性炭、活性アルミナなど、吸着性を有するものであれば種々のものを使用できる。

【００２８】また、第１吸着冷凍機Ａで用いる吸着材５ａ，５ｂと第２吸着冷凍機Ｂで用いる吸着材６ａ，６ｂとは同一のもの、あるいは、互いに異なるもののいずれであってもよい。

【００２９】冷媒Ｒには水を使用するのが一般的であるが、吸脱着が可能なものであれば、その他、種々のものを使用でき、また、第１吸着冷凍機Ａで用いる冷媒Ｒと第２吸着冷凍機Ｂで用いる冷媒Ｒとは同一のもの、あるいは、互いに異なるもの（例えば、第１吸着冷凍機Ａに冷媒Ｒにアルコールと用い、第２吸着冷凍機Ｂにおいて冷媒Ｒに水を用いるなど）のいずれであってもよい。

【図面の簡単な説明】

【図１】装置構成、及び、第１吸脱着運転の運転形態を示す図

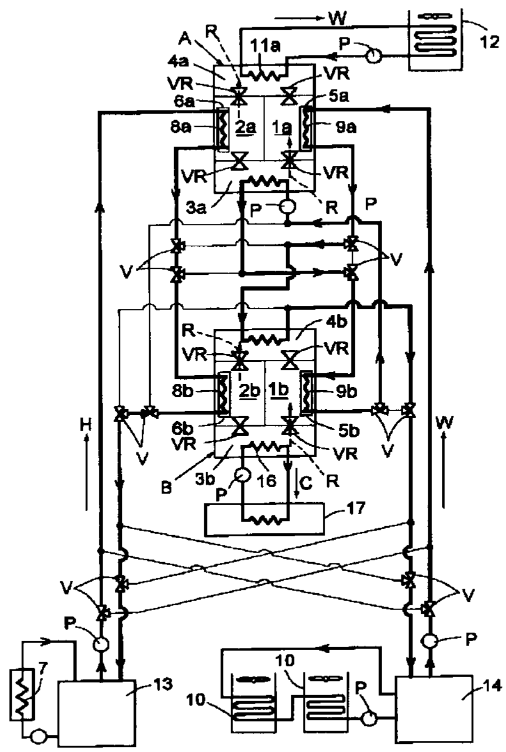
【図２】第２吸脱着運転の運転形態を示す図

【図３】相対圧と平衡吸着量との関係を示すグラフ。

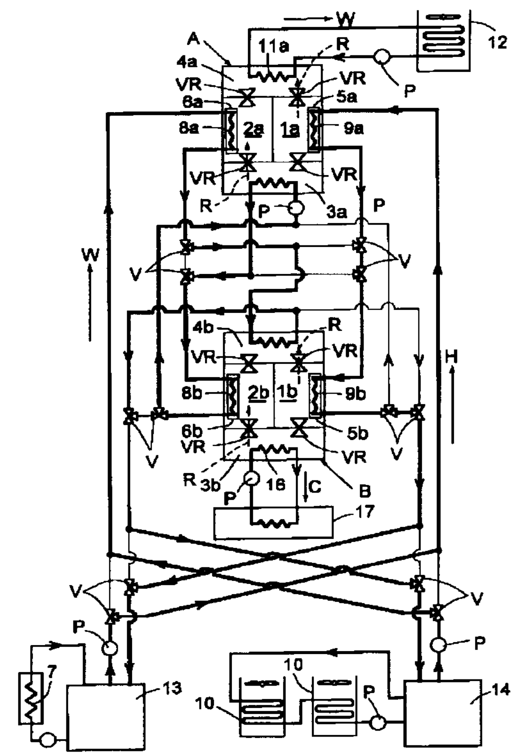
【符号の説明】

Ａ	第１吸着冷凍機
Ｂ	第２吸着冷凍機
１５	第１吸着冷凍機の冷熱発生部
８ｂ，９ｂ	第２吸着冷凍機の吸着材冷却部
７	共通の高温熱源
Ｘ	低温熱媒
Ｈ	脱着用高温熱媒

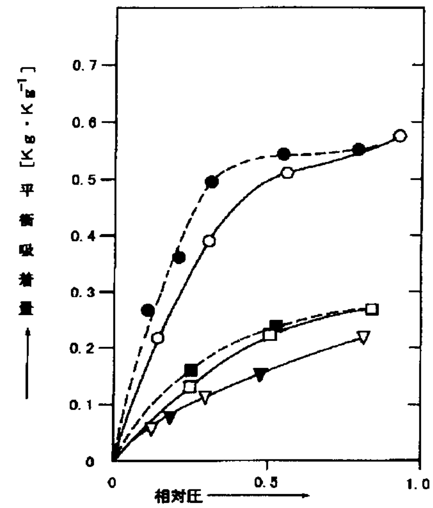
【図1】


W
12
A
R
11a
P
4a
VR
VR
6a
5a
8a
2a
1a
9a
VR
VR
3a
P
R
P
V
V
R
4b
VR
VR
8b
2b
1b
9b
6b
5b
VR
VR
H
W
V
V
B
3b
16
C
R
P
17
V
V
P
P
7
13
10
10
P
14

【図2】


W
12
A
11a
R
4a
VR
VR
P
6a
5a
8a
2a
1a
9a
VR
VR
R
P
3a
P
W
V
V
4b
R
VR
VR
H
8b
2b
1b
9b
6b
5b
VR
VR
V
V
R
3b
16
C
B
P
17
V
V
P
P
7
13
10
10
P
14

【図３】



T [°K]	吸着	脱着
303	─○─	--●--
343	─□─	--■--
363	─▽─	--▼--